DRAFT

BAY AREA

'97 CLEAN AIR PLAN

Volume IV

APPENDIX G

Source Inventory Description

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Prepared by
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EMISSION INVENTORY--OVERVIEW

Background

An emission inventory is an itemized list of emission estimates for sources of air pollution in a given area, for a specified time period. Present and future year inventories are critical components of air quality planning and modeling. The ultimate goal of the planning process is to identify and achieve a level of emissions which does not result in violation of national and state ambient air quality standards.

The BAAQMD began preparing emissions inventories in 1957. The current emission inventory to be used for planning is different from traditional inventory reports, which show annual average emissions by county. For ozone, a typical summer day inventory is needed, since ozone levels are highest during summer.

The inventory is divided into stationary (point, area and biogenic) and mobile source emissions. Stationary source emissions are calculated by the BAAQMD using various procedures. Emission computation methodology by source categories is set forth in the BAAQMD publication "Source Category Methodologies." The BAAQMD participates in the California Emission Inventory Technical Advisory Committee (EITAC) and maintains the best available inventory methodologies.

Many area source categories are further classified into sub-categories for better emission computation, speciation, regulation development, and future year projections. For example, emissions from aircraft categories are subdivided into various aircraft types at each of the airports in the Bay Area. Architectural coating categories are subdivided into various types of coatings and varnishes to account for varying solvent content. There are more than 900 different sub-categories used in this inventory. Emissions for categories affected by regulations are adjusted to reflect the controls required and the estimated rule effectiveness achieved.

Stationary Source Emissions

Point Sources. Sources identified on an individual facility or source basis are called point sources. Refineries and industrial plants are examples of point sources. The emission characteristics of individual facilities vary widely and each facility is examined individually. The Permit Services Division of the BAAQMD collects and maintains a computer data bank with detailed information on point sources. Almost all facilities emitting greater than 2.5

tons/year of any air pollutant are included. The 1996 base year inventory accounts for about 3,900 facilities, with 20,000 different sources. There are about 35,000 different facility processes, because some sources have more than one process (e.g., boilers burning different fuels, tanks storing different materials, and painting/printing operations using different coatings).

Data on the activity, seasonal variations, and hours of operation are collected at the process level from each facility. Parameters which affect the quantity of emissions are updated regularly. Emissions are calculated using the detailed data for each of the 7,000 facility processes listed as storage of organic liquid, and 10,000 facility processes listed as organic solvent users. The emissions from combustion and other general processes are computed using generalized or specific emission factors. These factors are periodically reviewed and updated.

Area Sources. Those stationary sources which are not identified individually are called area sources. This term is sometimes extended to cover numerous small point sources such as dry cleaners or gas stations which are known (at least potentially) individually. It always includes the diverse, unpermitted small sources which individually do not emit significant amounts of pollutants but which together make an appreciable contribution to the emission inventory. Examples of area sources are residential heating equipment and use of paints, varnishes, and consumer products. Emissions from these sources are grouped into categories and calculated based on surrogate variables. Information on these surrogates is usually available for the State or by county. Selected surrogates are used to apportion the category emissions into diurnal and spatial patterns. Emissions for some source categories are estimated by the California Air Resources Board (ARB) based on statewide data.

Biogenic Sources. In addition to man-made air pollution, there are significant quantities of pollutants from natural sources such as plants, animals, marshes, and the earth itself. Vegetation for example, emits large amounts of isoprene, terpenes, and other organic compounds which are precursors of ozone. Emission rates depend upon species, season, biomass density, time of day, local temperature, moisture and other factors. Total reactive organic emissions from Bay Area vegetation are about 300 tons per day and are not included in the Planning Inventory. Biogenic emission estimates are developed using a personal computer version of the Biogenic Emissions Inventory System (PC-BEIS).

Mobile Source Emissions

Mobile sources consist of on-road motor vehicles and other mobile sources.

On-Road Motor Vehicles. These consist of passenger cars, trucks, buses and motorcycles. Emissions from on-road motor vehicles are a major portion of the emissions inventory and are estimated using computer models developed by ARB. The models are referred to as Motor Vehicle Emission Inventory (MVEI). The latest version used for this inventory is MVEI 7G Version 1.0, which consists of two major parts: EMFAC and BURDEN. EMFAC calculates emission rates for a variety of vehicle types (passenger cars, trucks, etc.), fuel usage, control technology and mode of operation. It also accounts for vehicle age, and operating conditions such as speed and temperature. Emission factors are produced for summer and winter operations

to reflect the type of fuel in use, such as winter-time oxygenated fuel and summer-time fuel which has lower volatility (lower Reid Vapor Pressure) than winter. Emission reductions resulting from California's Inspection and Maintenance ("Smog Check") program are incorporated. EMFAC7G was used for this inventory.

BURDEN uses emission factors from EMFAC and a large data base of activity for each county to calculate total daily emissions. The activity is in the form of number of in-use vehicles, number of starts and vehicle miles traveled (VMT) for each vehicle type. The VMT data for these calculations are developed using MTC's regional travel model. Vehicle population is derived from Department of Motor Vehicle (DMV) data and starts are based on the population data and ARB guidelines.

Other Mobile Sources. These sources include boats, ships, trains, and aircraft, as well as garden, farm and construction equipment. Various methodologies are used for compilation of emissions for these mobile sources. Emission factors and methodologies for these sources are provided by ARB and EPA. Aircraft mix and activity data specific to each airport were used in estimating emissions at airports.

Planning Inventory

A planning inventory is a seasonal inventory representing emissions when a pollutant's concentrations are at their highest levels. For example, the emission inventory for the ozone season represents emissions occurring during the summer when ozone levels are highest. The emission inventory for the particulates season represents emissions occurring during the winter when particulate levels are highest. The seasonal inventories (summer and winter) are prepared based on the ARB's published guidelines described below.

The point source emissions are based on "average annual operating day" during the year. Therefore the summer and winter point source emissions are the same. Area source emissions are based on "average seasonal operating day". The summer season is considered May through October and the winter season is considered November through April. Data on normal operating schedules (hours per day, days per week and weeks per year) are collected as part of routine point source inventory procedures. For area sources, representative profiles showing monthly, weekly, and daily variation in emissions are prepared for each source category. These profiles are then used to obtain average seasonal operating day emissions.

For on-road motor vehicles, the MVEI7G V1.0 was used to develop planning inventories. The emission estimates for these inventories are based on ambient temperature profiles representing the ten days having the highest pollution levels. Summer temperature profiles are used to generate the ozone-precursor (ROG and NO_x) emission inventory, and winter temperature profiles are used for PM_{10} emissions.

BURDEN divides the day into six different time periods consistent with motor vehicle activity patterns, including the morning and evening commute periods. These six periods are: 12am - 6am, 6am - 9am, 9am - 12pm, 12pm - 3pm, 3pm - 6pm, and 6pm - 12am. For each period,

specific temperatures, activity data and vehicle speeds are used to estimate emissions. The emissions from the six periods are then summed to get daily emissions.

The above calculations are carried out for each county. For Solano and Sonoma, only the portions under District jurisdiction are represented. As mentioned earlier, a distribution of vehicle miles traveled, vehicle trips and average vehicle speed for each county was derived from data supplied by MTC. The number of vehicles by vehicle class (e.g., light duty truck, motorcycle, etc.) was based on vehicle registration information supplied by ARB.

Recent Legal Requirements

There is a good deal of evidence and expert opinion that indicate that real-world motor vehicle emissions may be significantly higher than the current inventory estimates derived from California's emissions model "MVEI7G." Some claim that actual emissions may be as high as two to three times the current estimates. But a recent study by U.C. Berkeley and the Air District, *A Fuel-Based Motor Vehicle Emission Inventory for the San Francisco Bay Area*, indicates that actual on-road motor vehicle ROG emissions are approximately 60% higher than the current estimates shown in the 1997 CAP.

To address this and other uncertainty issues associated with the inventory, a 1996 law (SB 2174 - Polanco) requires that "the state board shall, not later than January 1, 1998, and triennially thereafter, approve, following a public hearing, an update to the emission inventory...". It states later that "The Legislature hereby finds and declares that it is in the interests of the state that air quality plans be based on accurate emissions inventories. Inaccurate inventories that do not reflect the actual emissions into the air can lead to misdirected air quality control measures, resulting in delayed attainment of standards and unnecessary and significant costs."

As a result, ARB staff have been studying this issue and have held a number of workshops. They are reviewing available data and modifying test methods in an effort to improve the accuracy of the mobile source inventory. The next formal update of the MVEI has not yet been scheduled.

1996 EMISSION INVENTORY AND BASELINE PROJECTIONS

Baseline emission inventory projections for future years are essential for evaluating the impact of proposed control measures. Future baseline emissions are forecast from the base year (1996) emission inventory by utilizing projected growth rates and calculating the year-by-year effectiveness of already-adopted control measures. Historical emissions are based on previously compiled inventories with changes if more information is now available. Total baseline emissions for the years 1990, 1994, 1997, 2000, 2003 and 2010 are shown in Table G-1, and the emissions by major source categories for the years 1990, 1994, 1997, 2000 and 2003 are shown in Table G-3. The emissions are presented in tons/day for Reactive Organic Compounds (ROG), Oxides of Nitrogen (NO_x), and Particulate Matter (PM_{10}). As mentioned earlier, the ROG and NO_x emissions are based on summer day and PM_{10} emissions are based on a winter day. Reactive organic emissions are derived from total organic emissions by excluding the nonreactive organic compounds listed in Table G-2.

TABLE G-1

TOTAL BASELINE EMISSIONS IN THE BAY AREA AIR BASIN

(Tons per planning day)

Pollutant	1990	1994	1997	2000	2003	2010
ROG	687	576	492	449	413	365
NO_x	708	662	598	530	474	438
PM_{10}	200	187	206	217	225	241

TABLE G-2

NONREACTIVE COMPOUNDS

1. Methane
2. Methylene chloride
3. Methyl Chloroform (1,1,1 Trichloroethane)
4. Trichlorotrifluoroethane (CFC-113)
5. Trichlorofluoromethane (CFC-111)
6. Dichlorodifluoromethane (CFC-12)
7. Chlorodifluoromethane (CFC-22)
8. Trifluoromethane (CFC-23)
9. Dichlorotetrafluoroethane (CFC-114)
10. Chloropentafluoroethane (CFC-115)

Table G-3
Bay Area Baseline Emission Inventory Projections : 1990 - 2003
Planning Inventory (Tons/Day)

	Reactive Organics					Oxides of Nitrogen					Particulates (PM-10)				
	1990	1994	1997	2000	2003	1990	1994	1997	2000	2003	1990	1994	1997	2000	2003
IND/COMMERCIAL PROCESSES															
PETROLEUM REFINING FACILITIES															
Basic Refining Processes	0.09	0.10	0.10	0.10	0.10	5.79	6.05	6.17	6.37	6.37	1.02	1.07	1.09	1.13	1.13
Wastewater (Oil-Water) Separators	4.42	3.70	3.77	3.89	3.89	---	---	---	---	---	---	---	---	---	---
Wastewater Treatment Facilities	0.08	0.08	0.09	0.03	0.04	---	---	---	---	---	---	---	---	---	---
Cooling Towers	2.36	2.46	2.51	0.86	1.24	---	---	---	---	---	---	---	---	---	---
Flares and Blowdown Systems	0.27	0.12	0.11	0.10	0.15	6.30	2.78	2.54	2.30	3.32	0.05	0.02	0.02	0.02	0.03
Other Refining Processes	0.81	0.85	0.87	0.30	0.43	---	---	---	---	---	0.08	0.09	0.09	0.03	0.04
Fugitives	10.70	9.70	8.45	8.45	8.45	---	---	---	---	---	---	---	---	---	---
Sub total	**18.74**	**17.01**	**15.89**	**13.72**	**14.30**	**12.09**	**8.83**	**8.71**	**8.67**	**9.69**	**1.15**	**1.18**	**1.20**	**1.18**	**1.20**
CHEMICAL MANUFACTURING FACILITIES															
Sulfur Mfg.	0.08	0.08	0.08	0.09	0.09	0.07	0.06	0.06	0.07	0.07	---	---	---	---	---
Coatings & Inks Mfg.	0.56	0.48	0.49	0.50	0.51	---	---	---	---	---	0.04	0.04	0.05	0.05	0.05
Resins Mfg.	0.04	0.04	0.05	0.05	0.05	---	---	---	---	---	---	---	---	---	---
Other Chemicals Mfg.	0.85	0.83	0.84	0.88	0.92	1.60	1.55	1.58	1.64	1.73	1.16	1.11	1.14	1.20	1.27
Fugitives (all mfg.)- Valves & Flanges	0.30	0.30	0.32	0.34	0.36	---	---	---	---	---	---	---	---	---	---
Sub total	**1.83**	**1.74**	**1.78**	**1.85**	**1.93**	**1.67**	**1.61**	**1.64**	**1.71**	**1.80**	**1.20**	**1.15**	**1.19**	**1.25**	**1.32**
OTHER INDST/COMMER. PROCESSES															
Bakeries	1.95	1.27	1.26	1.29	1.32	---	---	---	---	---	---	---	---	---	---
Cooking	1.17	1.23	1.29	1.37	1.46	---	---	---	---	---	6.12	6.41	6.75	7.16	7.60
Wineries	0.45	0.67	0.82	0.99	1.22	---	---	---	---	---	---	---	---	---	---
Other Food & Agricultural Processes	0.17	0.18	0.19	0.19	0.20	---	---	---	---	---	1.59	1.63	1.71	1.77	1.83
Metallurgical	0.05	0.04	0.04	0.04	0.04	0.01	---	---	0.01	0.01	1.69	1.24	1.31	1.37	1.39
Asphalt Concrete Plants	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.37	0.34	0.40	0.41	0.42
Glass & Related Products Mfg.	0.02	0.02	0.02	0.02	0.02	0.88	0.76	0.84	0.88	0.92	2.17	1.87	2.07	2.17	2.26
Stone, Sand & Gravel	0.02	0.03	0.03	0.04	0.04	---	---	---	---	---	0.53	0.44	0.51	0.56	0.62
Oil Production Fields	0.08	0.05	0.04	0.04	0.04	---	---	---	---	---	---	---	---	---	---

Table G-3
Bay Area Baseline Emission Inventory Projections : 1990 - 2003
Planning Inventory (Tons/Day)

	Reactive Organics					Oxides of Nitrogen					Particulates (PM-10)				
	1990	1994	1997	2000	2003	1990	1994	1997	2000	2003	1990	1994	1997	2000	2003
Gas Production Fields	0.13	0.15	0.17	0.19	0.22	---	---	---	---	---	---	---	---	---	---
Waste Management	3.28	3.54	3.57	3.47	3.32	0.20	0.21	0.23	0.25	0.27	0.81	0.87	0.96	1.07	1.19
Semiconductor Manufacturing	0.59	0.60	0.61	0.62	0.63	---	---	---	---	---	---	---	---	---	---
Flexible & Rigid Discs Manufacturing	0.02	0.02	0.02	0.02	0.02	---	---	---	---	---	---	---	---	---	---
Fiberglass Products Manufacturing	2.81	0.51	0.53	0.56	0.59	---	---	---	---	---	---	---	---	---	---
Rubber Products Manufacturing	0.15	0.17	0.19	0.19	0.20	---	---	---	---	---	---	---	---	---	---
Plastic Products Manufacturing	0.68	0.65	0.66	0.69	0.70	0.03	0.03	0.03	0.03	0.03	0.14	0.14	0.14	0.15	0.15
Contaminated Soil Aeration	4.09	4.07	4.07	3.08	1.56	---	---	---	---	---	---	---	---	---	---
Soil Vapor Extraction & Air Stripping	1.82	0.56	0.57	0.59	0.62	0.12	0.11	0.11	0.12	0.13	0.06	0.06	0.06	0.06	0.06
Other Industrial Commercial	0.82	0.77	0.77	0.81	0.84	0.19	0.19	0.19	0.20	0.20	7.84	7.56	7.80	8.16	8.54
Sub total	**18.33**	**14.55**	**14.87**	**14.23**	**13.07**	**1.45**	**1.32**	**1.43**	**1.51**	**1.57**	**21.33**	**20.56**	**21.71**	**22.88**	**24.08**
PETROLEUM PROD/SOLVENT EVAP.															
PETROLEUM REFINERY															
Storage Tanks	7.43	6.99	7.16	7.30	7.34	---	---	---	---	---	---	---	---	---	---
Loading Operations	2.68	2.58	2.64	2.72	2.72	---	---	---	---	---	---	---	---	---	---
Sub total	**10.11**	**9.57**	**9.80**	**10.02**	**10.06**										
FUELS DISTRIBUTION															
Natural Gas Distribution	0.39	0.42	0.44	0.46	0.47	---	---	---	---	---	---	---	---	---	---
Bulk Plants (Gasoline Only)	0.93	0.82	0.69	0.70	0.71	---	---	---	---	---	---	---	---	---	---
Bulk Plants and Terminals (Non-Gasoline)	0.04	0.04	0.04	0.04	0.04	---	---	---	---	---	---	---	---	---	---
Loading Trucks	0.47	0.46	0.47	0.47	0.48	---	---	---	---	---	---	---	---	---	---
Trucking	0.17	0.15	0.13	0.13	0.13	---	---	---	---	---	---	---	---	---	---
Gasoline Filling Stations	7.91	6.41	5.83	5.88	5.93	---	---	---	---	---	---	---	---	---	---
Aircraft Fueling	1.81	2.13	2.18	2.23	2.23	---	---	---	---	---	---	---	---	---	---
Recreational Boat Fueling	0.84	0.82	0.86	0.89	0.93	---	---	---	---	---	---	---	---	---	---
Ferry & Fishing Boats Fueling	0.17	0.16	0.17	0.17	0.18	---	---	---	---	---	---	---	---	---	---
Other Fueling	0.58	0.62	0.64	0.67	0.69	---	---	---	---	---	---	---	---	---	---
Sub total	**13.30**	**12.02**	**11.45**	**11.65**	**11.78**										

Table G-3
Bay Area Baseline Emission Inventory Projections : 1990 - 2003
Planning Inventory (Tons/Day)

	Reactive Organics					Oxides of Nitrogen					Particulates (PM-10)				
	1990	1994	1997	2000	2003	1990	1994	1997	2000	2003	1990	1994	1997	2000	2003
OTHER ORG. COMPOUNDS EVAP.															
Industrial Degreasing	3.36	3.40	3.44	3.47	3.50	---	---	---	---	---	---	---	---	---	---
Commercial Degreasing	2.31	2.34	2.37	2.39	2.41	---	---	---	---	---	---	---	---	---	---
Dry Cleaners	0.14	0.14	0.15	0.15	0.15	---	---	---	---	---	---	---	---	---	---
Printing	10.00	9.26	7.85	7.07	6.32	---	---	---	---	---	---	---	---	---	---
Adhesives & Sealants	18.00	19.80	12.40	11.60	12.00	---	---	---	---	---	---	---	---	---	---
Structures Coating	23.30	22.20	22.40	22.10	22.10	---	---	---	---	---	---	---	---	---	---
Industrial/Commercial Coating	37.60	32.90	32.20	33.80	35.70	---	---	---	---	---	---	---	---	---	---
Storage Tanks	1.48	1.36	1.43	1.53	1.60	---	---	---	---	---	---	---	---	---	---
Lightering	0.82	0.07	0.07	0.07	0.07	---	---	---	---	---	---	---	---	---	---
Ballasting	1.62	1.60	1.79	1.85	1.85	---	---	---	---	---	---	---	---	---	---
Marine Vessel Cleaning & Gas Freeing	0.71	0.67	0.70	0.72	0.72	---	---	---	---	---	---	---	---	---	---
Sterilizers	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Marine Loading (Non-Refinery)	5.05	0.21	0.22	0.22	0.22	---	---	---	---	---	---	---	---	---	---
Asphalt Paving	0.29	0.28	0.30	0.33	0.35	---	---	---	---	---	---	---	---	---	---
Other Organics Evaporation	0.54	0.88	0.85	0.82	0.78	---	---	---	---	---	---	---	---	---	---
Sub total	**105.21**	**95.10**	**86.15**	**86.12**	**87.78**										
COMBUSTION - STATIONARY SOURCES															
FUELS COMBUSTION															
Domestic	2.07	1.95	2.00	2.05	2.11	10.50	11.00	10.60	10.00	9.09	34.40	35.00	35.70	36.10	36.90
Cogeneration	0.64	0.70	0.72	0.75	0.78	10.00	10.20	8.69	6.03	5.26	0.51	0.53	0.55	0.56	0.59
Power Plants	0.06	0.07	0.07	0.07	0.07	11.80	13.30	12.20	10.90	7.05	0.29	0.38	0.37	0.34	0.36
Oil Refineries External Combustion	0.31	0.30	0.30	0.31	0.31	22.40	22.20	22.30	18.90	6.33	1.55	1.48	1.49	1.50	1.51
Glass Melting Furnaces - Natural Gas	---	---	---	---	---	4.28	4.41	4.24	3.97	3.84	---	---	---	---	---
Reciprocating Engines	0.43	0.38	0.40	0.43	0.45	11.00	9.22	7.65	4.86	3.98	0.28	0.26	0.27	0.29	0.30
Turbines	0.14	0.15	0.15	0.15	0.16	1.80	2.11	2.13	2.15	2.17	0.23	0.25	0.25	0.26	0.26
Other External Combustion	0.81	1.20	1.28	1.36	1.44	47.10	63.40	49.20	27.90	29.40	2.29	2.73	2.90	3.06	3.22
Sub total	**4.46**	**4.76**	**4.93**	**5.11**	**5.30**	**118.88**	**135.84**	**117.01**	**84.71**	**67.12**	**39.54**	**40.62**	**41.53**	**42.10**	**43.14**

Table G-3
Bay Area Baseline Emission Inventory Projections : 1990 - 2003
Planning Inventory (Tons/Day)

	Reactive Organics					Oxides of Nitrogen					Particulates (PM-10)				
	1990	1994	1997	2000	2003	1990	1994	1997	2000	2003	1990	1994	1997	2000	2003
BURNING OF WASTE MATERIAL															
Incineration	0.66	0.70	0.73	0.76	0.78	1.13	1.20	1.24	1.29	1.33	0.79	0.83	0.87	0.90	0.94
Planned Fires	0.09	0.09	0.10	0.10	0.10	0.01	0.01	0.01	0.01	0.02	0.18	0.19	0.20	0.21	0.22
Sub total	**0.75**	**0.79**	**0.83**	**0.86**	**0.88**	**1.14**	**1.21**	**1.25**	**1.30**	**1.35**	**0.97**	**1.02**	**1.07**	**1.11**	**1.15**
COMBUSTION - MOBILE SOURCES															
OFF-HIGHWAY MOBILE SOURCES															
Lawn, Garden and Other Utility Equip.	11.60	12.60	10.00	7.40	6.05	0.52	0.57	0.60	1.11	1.13	0.09	0.09	0.10	0.06	0.06
Transportation Refrigeration Units	0.26	0.22	0.22	0.22	0.22	2.04	1.88	1.92	1.95	1.98	0.16	0.14	0.15	0.15	0.15
Farm Equipment	1.22	1.25	1.25	1.31	1.37	7.18	7.14	7.54	7.79	8.16	0.12	0.12	0.12	0.13	0.13
Heavy Duty Indust/Construction Equip.	1.93	1.79	1.83	1.84	1.90	22.10	21.60	22.90	23.50	24.30	0.79	0.77	0.82	0.84	0.87
Light Duty Indust/Construction Equip.	22.20	23.20	23.80	24.50	25.40	88.30	89.10	94.80	97.50	101.00	3.22	3.14	3.33	3.42	3.54
Locomotive Operations	0.52	0.51	0.49	0.48	0.48	12.10	11.80	11.50	11.20	11.10	0.25	0.24	0.24	0.23	0.23
Off Road Motorcycles	2.73	2.29	1.89	1.58	1.47	0.20	0.17	0.14	0.12	0.11	---	---	---	---	---
All Terrain Vehicles	0.94	0.79	0.67	0.56	0.52	0.03	0.03	0.02	0.02	0.02	---	---	---	---	---
Four-wheel Drive Vehicles	0.12	0.12	0.11	0.11	0.11	0.09	0.09	0.08	0.08	0.08	0.01	0.01	0.01	0.01	0.01
Ships Maneuvering	0.23	0.22	0.24	0.25	0.26	0.68	0.66	0.70	0.73	0.75	0.09	0.09	0.10	0.10	0.10
Ships Berthing	0.42	0.41	0.44	0.46	0.47	2.26	2.20	2.33	2.43	2.52	0.25	0.24	0.26	0.27	0.28
Ships In-Transit	0.66	0.65	0.68	0.71	0.74	2.23	2.17	2.30	2.40	2.49	0.31	0.30	0.32	0.34	0.35
Commercial Boats	0.47	0.50	0.52	0.54	0.57	1.85	2.03	2.18	2.30	2.43	0.17	0.19	0.21	0.22	0.23
Recreational Boats	15.90	16.90	17.30	18.10	18.90	1.22	1.38	1.50	1.62	1.75	0.23	0.24	0.25	0.26	0.27
Sub total	**59.20**	**61.45**	**59.45**	**58.06**	**58.46**	**140.80**	**140.80**	**148.51**	**152.74**	**157.82**	**5.69**	**5.59**	**5.89**	**6.02**	**6.22**
AIRCRAFT															
Commercial Aircraft	5.29	6.20	5.46	5.55	5.63	10.40	13.10	12.00	12.20	12.10	---	---	---	---	---
General Aviation	1.44	1.45	1.55	1.65	1.75	0.35	0.36	0.38	0.41	0.43	---	---	---	---	---
Military Aircraft	10.60	8.92	7.19	7.35	7.81	4.56	3.82	3.18	3.28	3.50	4.62	3.83	2.69	2.63	2.76
Agricultural Aircraft	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Airport Ground Support Equipment	0.17	0.16	0.16	0.17	0.17	0.50	0.47	0.48	0.49	0.50	0.01	0.01	0.01	0.01	0.01
Sub total	**17.50**	**16.73**	**14.36**	**14.72**	**15.36**	**15.81**	**17.75**	**16.04**	**16.38**	**16.53**	**4.63**	**3.84**	**2.70**	**2.64**	**2.77**

Table G-3
Bay Area Baseline Emission Inventory Projections : 1990 - 2003
Planning Inventory (Tons/Day)

	Reactive Organics					Oxides of Nitrogen					Particulates (PM-10)				
	1990	1994	1997	2000	2003	1990	1994	1997	2000	2003	1990	1994	1997	2000	2003
ON ROAD MOTOR VEHICLES															
Light Duty Passenger	237.40	179.80	137.40	114.10	88.40	197.60	162.00	132.90	111.60	88.30	2.87	2.61	2.53	2.51	2.52
Light Duty Trucks	105.70	78.30	55.90	43.00	30.80	103.70	93.10	76.80	64.50	50.80	1.13	1.02	0.97	0.96	0.98
Medium Duty Trucks	8.19	9.24	7.71	7.40	6.31	10.40	12.40	12.80	13.70	12.50	0.07	0.09	0.12	0.15	0.17
Light Heavy Duty Trucks	5.61	3.64	2.46	2.09	1.84	18.50	17.70	15.50	14.40	13.10	0.64	0.81	0.59	0.51	0.49
Medium Heavy Duty Trucks	5.70	3.21	2.09	1.68	1.54	17.80	15.20	15.10	14.20	13.30	1.77	1.23	0.85	0.64	0.55
Heavy Heavy Duty Trucks	5.69	4.62	3.51	2.79	2.44	54.00	40.30	36.10	31.00	26.80	5.88	3.58	2.58	1.88	1.45
Heavy Duty Buses	0.52	0.53	0.52	0.52	0.52	5.60	5.27	5.05	4.82	4.45	0.15	0.10	0.06	0.05	0.03
Motorcycles	2.77	2.04	1.78	1.78	1.88	0.88	0.92	1.12	0.99	0.96	0.04	0.05	0.05	0.05	0.05
Sub total	**371.58**	**281.38**	**211.37**	**173.36**	**133.73**	**408.48**	**346.89**	**295.37**	**255.21**	**210.21**	**12.56**	**9.49**	**7.75**	**6.74**	**6.23**
MISC. OTHER SOURCES															
Construction Operations	---	---	---	---	---	---	---	---	---	---	36.00	21.10	32.80	39.80	42.20
Farming Operations	---	---	---	---	---	---	---	---	---	---	1.02	1.04	1.00	1.03	1.05
Entrained Road Dust	---	---	---	---	---	---	---	---	---	---	64.70	69.30	72.70	76.10	79.40
Accidental Fires	0.40	0.40	0.40	0.41	0.41	0.12	0.13	0.13	0.13	0.13	0.23	0.24	0.25	0.26	0.26
Animal Waste	3.16	3.26	3.40	3.53	3.68	---	---	---	---	---	4.17	4.31	8.45	8.78	9.15
Wind Blown Dust	---	---	---	---	---	---	---	---	---	---	6.70	7.30	7.30	7.30	7.30
Agricultural Pesticides	2.75	2.68	2.53	2.42	2.31	---	---	---	---	---	---	---	---	---	---
Non-Agricultural Pesticides	4.44	4.56	3.82	3.80	3.84	---	---	---	---	---	---	---	---	---	---
Consumer Products (no pesticides)	47.40	42.50	43.10	41.70	42.90	---	---	---	---	---	---	---	---	---	---
Other Misc. Sources	0.53	0.53	0.56	0.61	0.64	0.06	0.07	0.07	0.07	0.08	0.91	1.00	1.05	1.09	1.13
Sub total	**58.15**	**53.40**	**53.25**	**51.86**	**53.14**	**0.12**	**0.13**	**0.13**	**0.13**	**0.13**	**112.82**	**103.29**	**122.50**	**133.27**	**139.36**
BANKING EMISSIONS	7.71	7.71	7.71	7.71	7.71	7.44	7.44	7.44	7.44	7.44	---	---	---	---	---
Grand total	**687**	**576**	**492**	**449**	**413**	**708**	**662**	**598**	**530**	**474**	**200**	**187**	**206**	**217**	**225**

Estimation of Future Emissions

Baseline future year emissions for each source category are calculated from the base year (1996) emissions using the following equation:

$$EM_{FY} = EM_{BY} \times CF \times GF$$

where:

- EM_{FY} is the forecasted emissions of an air pollutant for any future year,
- EM_{BY} represents the base year emissions of the air pollutant (1996 is the base year in this forecast),
- CF (Control Factor) is an indicator for the level of control imposed as a result of current federal, State and regional air quality regulations, and
- GF (Growth Factor) is an estimate of growth or decline derived from best available data for the different categories. CF and GC are 1.0 for the base year 1996.

Control Factors

The impact of all adopted air pollution control rules are included in emission forecasts by means of control factors. For an individual source category, a future year control factor CF is calculated by the equation

$$CF_{FY} = \frac{E_{BY} - R}{E_{BY}}$$

where:

- E_{BY} is the base year 1996 emissions for a category affected by one or more of the air quality rules, and
- R is the sum of emission reductions from the applicable rules.

Thus CF is 1 for 1996 and less than one for years after 1996, if there are reductions from adopted rules. The control factors in this inventory take into account all federal, state and local air quality regulations in effect prior to December 1, 1996.

Growth Factors

Growth factors are developed for each source category based on population, housing and other parameters developed by the Association of Bay Area Governments (ABAG) and the ARB. The on-road motor vehicle growth rates for the year 2003 are shown in Table G-4 by vehicle type and by county.

TABLE G-4

ON-ROAD MOTOR VEHICLE GROWTH FACTORS*

COUNTY	Alameda	Contra Costa	Marin	Napa	San Francisco	San Mateo	Santa Clara	Solano	Sonoma
Passenger Cars									
Non-Catalytic									
Vehicle	0.151	0.163	0.140	0.153	0.135	0.154	0.152	0.187	0.165
VMT	0.139	0.151	0.143	0.189	0.129	0.145	0.146	0.150	0.160
Starts	0.131	0.140	0.129	0.148	0.122	0.127	0.129	0.168	0.145
Catalytic									
Vehicle	1.235	1.329	1.142	1.252	1.106	1.259	1.246	1.526	1.346
VMT	1.232	1.335	1.254	1.621	1.137	1.281	1.289	1.314	1.414
Starts	1.302	1.395	1.283	1.478	1.222	1.267	1.286	1.672	1.447
Diesel									
VMT	0.105	0.114	0.111	0.125	0.094	0.109	0.109	0.109	0.125
Starts	0.205	0.220	0.203	0.233	0.193	0.200	0.203	0.264	0.228
Light and Medium Duty Trucks									
Non-Catalytic									
Vehicle	0.014	0.015	0.013	0.014	0.012	0.014	0.014	0.017	0.015
VMT	0.011	0.014	0.012	0.026	0.007	0.009	0.015	0.016	0.009
Starts	0.014	0.015	0.014	0.016	0.013	0.014	0.014	0.018	0.015
Catalytic									
Vehicle	1.504	1.636	1.428	1.494	1.296	1.519	1.528	1.844	1.603
VMT	1.454	1.592	1.520	1.873	1.290	1.497	1.532	1.538	1.632
Starts	1.581	1.713	1.600	1.759	1.427	1.524	1.573	2.015	1.719
Diesel									
VMT	0.110	0.111	0.071	0.083	0.087	0.103	0.122	0.098	0.108
Starts	0.224	0.243	0.227	0.249	0.202	0.216	0.223	0.286	0.244
Heavy Duty Trucks									
Non-Catalytic									
Vehicle	0.206	0.211	0.208	0.214	0.191	0.205	0.207	0.211	0.216
VMT	0.094	0.103	0.074	0.103	0.086	0.092	0.100	0.101	0.096
Starts	0.092	0.094	0.093	0.096	0.085	0.092	0.092	0.095	0.097
Catalytic									
Vehicle	3.898	3.977	3.923	4.032	3.598	3.868	3.899	3.989	4.087
VMT	2.924	3.185	3.040	3.857	2.632	3.000	3.077	3.172	3.396
Starts	3.049	3.111	3.067	3.149	2.815	3.026	3.050	3.116	3.194
Diesel									
VMT	1.192	1.395	1.138	1.516	0.882	1.261	1.310	1.488	1.481
Motorcycles									
Non-catalytic									
Vehicle	0.909	0.917	0.940	0.944	0.985	0.965	0.922	0.925	0.979
VMT	1.064	1.247	1.010	1.417	0.795	1.119	1.166	1.344	1.306
Starts	1.206	1.296	1.192	1.373	1.116	1.164	1.191	1.552	1.341
Urban Buses									
Diesel									
VMT	1.061	1.111	1.167	1.000	1.000	1.050	1.050	1.333	1.429

* These factors give an estimate of projected growth in motor vehicle activity between 1990 and 2003.

** Growth factors for catalytic heavy duty trucks are high because the number of a catalytic heavy duty trucks in 1990 was very small. 1987 was the first year of catalytic converter use on heavy duty trucks.

Future Baseline Emissions

Total baseline emissions and the relative contributions by major source categories are shown in Figure G-1. Total emissions of ROG and NO_x decrease from the years 1990 to 2003 as follows: ROG (39%), NO_x (32%). PM_{10} emissions decreased from 1990 to 1994 due to a reduction in "miscellaneous other sources", which include PM_{10} emissions from construction operations, farming operations and entrained road dust. The reductions are due to the downturn in construction between 1990 and 1994 in the Bay Area. Total PM_{10} emissions then increased by approximately 2.8% per year up to 1997 due to increases in construction activity and increases in VMT. Future growth for PM_{10} is projected at 1.2% per year.

Relative contributions to emissions of ROG, NO_x, and PM_{10} by major source categories for the years 1990, 1994, 1997, 2000 and 2003 are shown in Figures G-2 to G-6. The figures show that relative contributions of ROG, NO_x, and PM_{10} emissions by motor vehicles are declining over the years due to various controls.

ROG Emissions

The most significant decrease in ROG emissions (372 tons/day in 1990, declining to 134 tons/day in 2003) is from motor vehicles. Lower emissions are attributed to the introduction of newer vehicles that comply with increasingly stringent exhaust and evaporative emission standards. In 1990, about 85% of the light duty vehicles in use were equipped with catalytic converters. By the year 2003, over 98% of all light duty vehicles on the road will have catalytic converters. The average emission rate for the light duty vehicles for year 2003 includes a non-methane hydrocarbon emission standard (NMHC), adopted in 1989, of 0.25 grams/mile. This is significantly more stringent than the previous standard of 0.39 grams per mile. A phase-in schedule for new vehicles that comply with the 0.25 grams/mile standard began in 1993 and will be completed by the end of 1997. Low Emission Vehicles (LEVs: 0.125 grams/mile NMHC) and Ultra Low Emission Vehicles (ULEVs: 0.075 grams mile NMHC) were introduced beginning 1994 and 1997 respectively. Further emission reductions are also expected due to the California Reformulated Gasoline Phase I (1992) and Phase II (1996). Additional reductions are also expected due to the implementation of the improved Inspection and Maintenance ("Smog Check") Program, which started in 1995.

Stationary source emissions under District jurisdiction show a ROG reduction of approximately 12% over the 13 year period beginning in 1990.

NO_x Emissions

NO_x emissions from motor vehicles decrease substantially (408 tons/day in 1990, declining to 210 tons/day in 2003) due to the increased proportion of light duty vehicles equipped with catalytic converters and implementation of increasingly more stringent NO_x exhaust emission standards. For passenger cars, a 0.4 grams/mile standard was

phased in over a two year period replacing the previous 0.7 grams/mile standard. In 1997, a 0.2 grams/mile standard was introduced for both LEVs and ULEVs.

PM_{10} Emissions

For 1997 (Figure G-4), 32% of winter PM_{10} is from stationary sources, 8% from motor vehicles (both on-road and off-road) and the remainder, 60% is from miscellaneous other sources. Table G-3 shows that wood burning during winter months contribute to half of the stationary source PM_{10} emissions (16% of total). Included in miscellaneous other source categories are two major source categories of PM_{10} emissions: construction operations (16%) and road dust produced by on-motor vehicles traveling on paved and unpaved roads (35%). Relative contributions of the major source categories to the total PM_{10} emissions are expected to remain the same for the foreseeable future.

Future Control Effects

All of the emission projections in this appendix represent baseline estimates, incorporating the effects of control measures already adopted. Some of these measures may have implementation schedules that extend beyond 2003. The rules, regulations and programs proposed in the 1997 CAP will further reduce emissions below the baseline projections.

FIGURE G-1
Emissions Trends

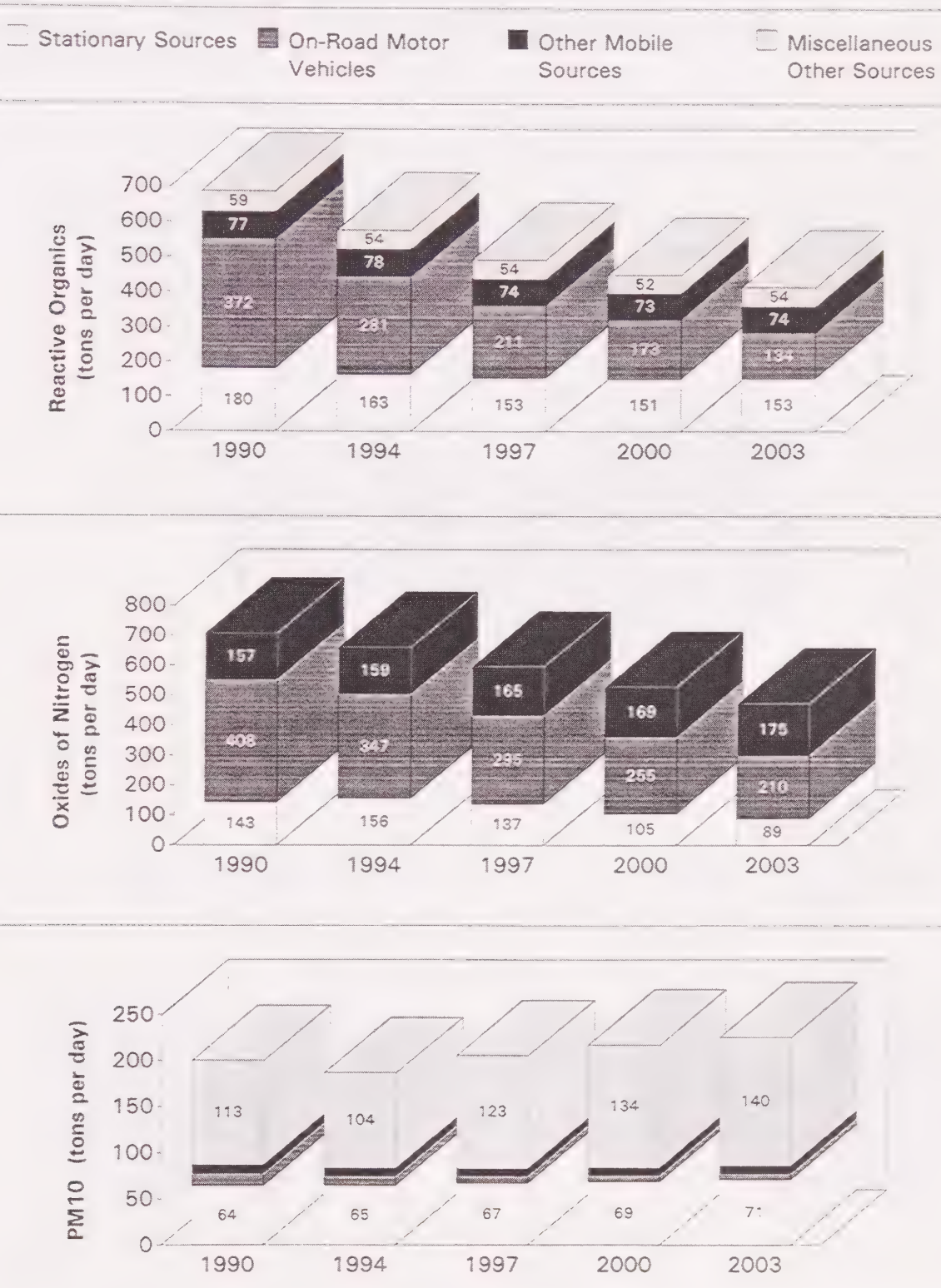
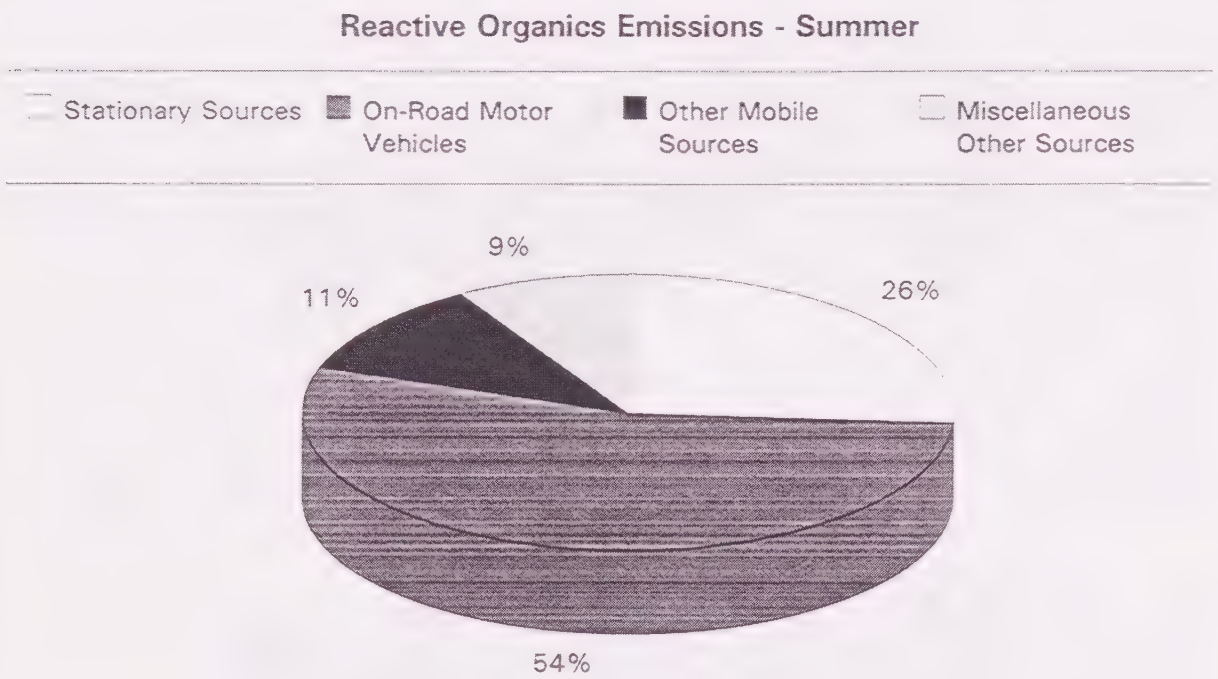
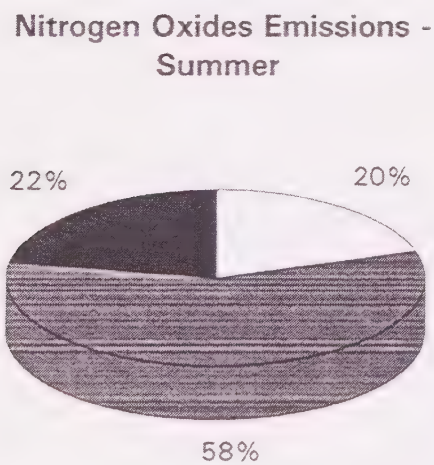


FIGURE G-2

Contribution of 1990 Emissions by Major Source Category





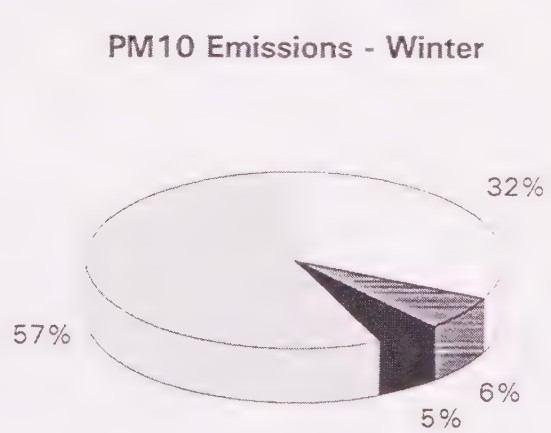
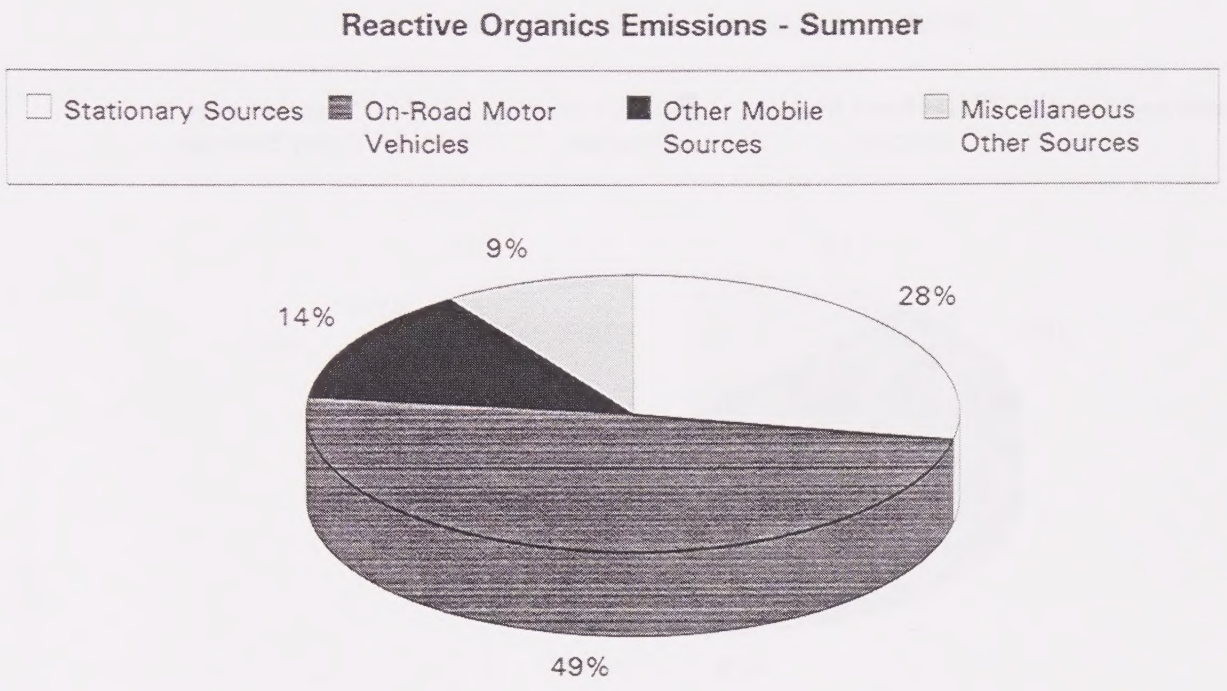
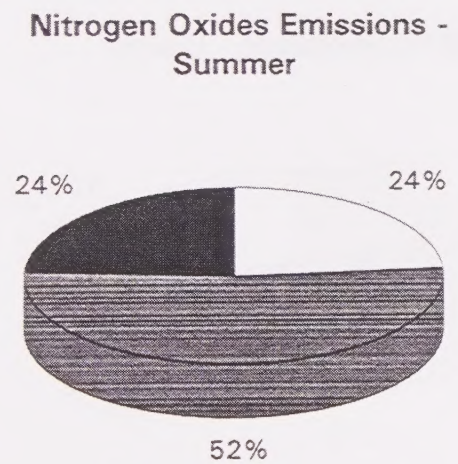


FIGURE G-3

Contribution of 1994 Emissions by Major Source Category





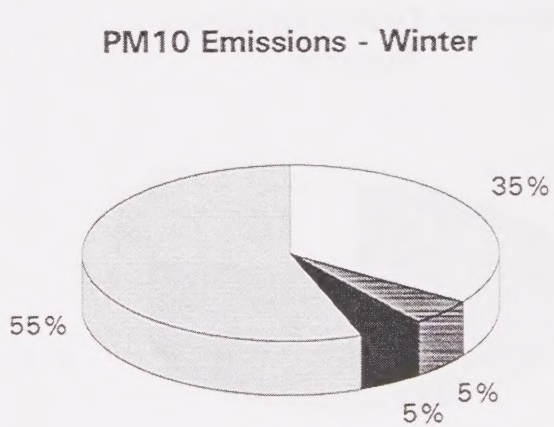
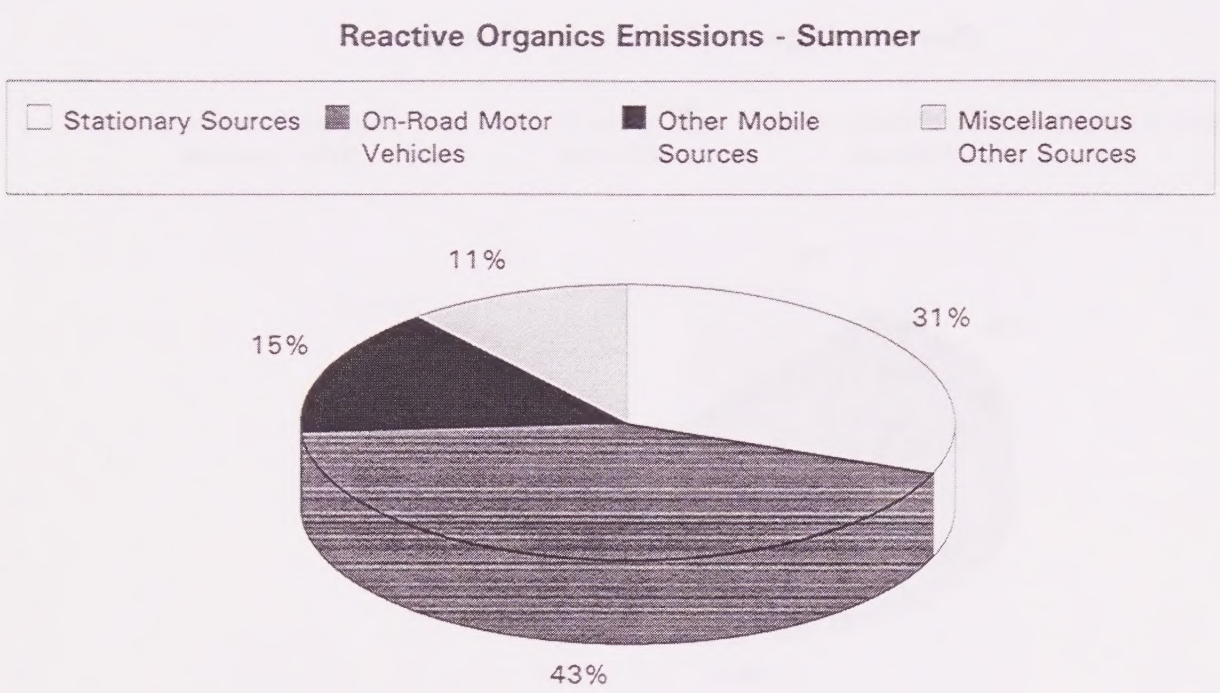
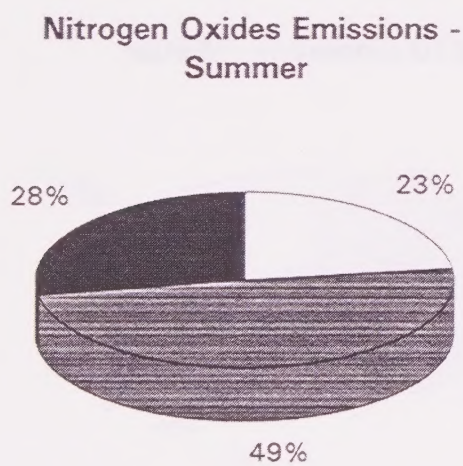


FIGURE G-4

Contribution of 1997 Emissions by Major Source Category





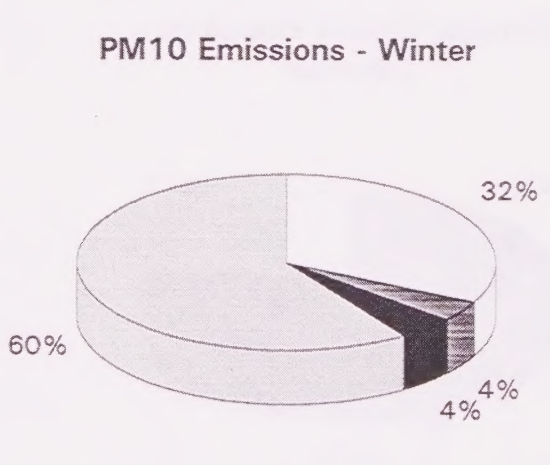


FIGURE G-5

Contribution of 2000 Emissions by Major Source Category

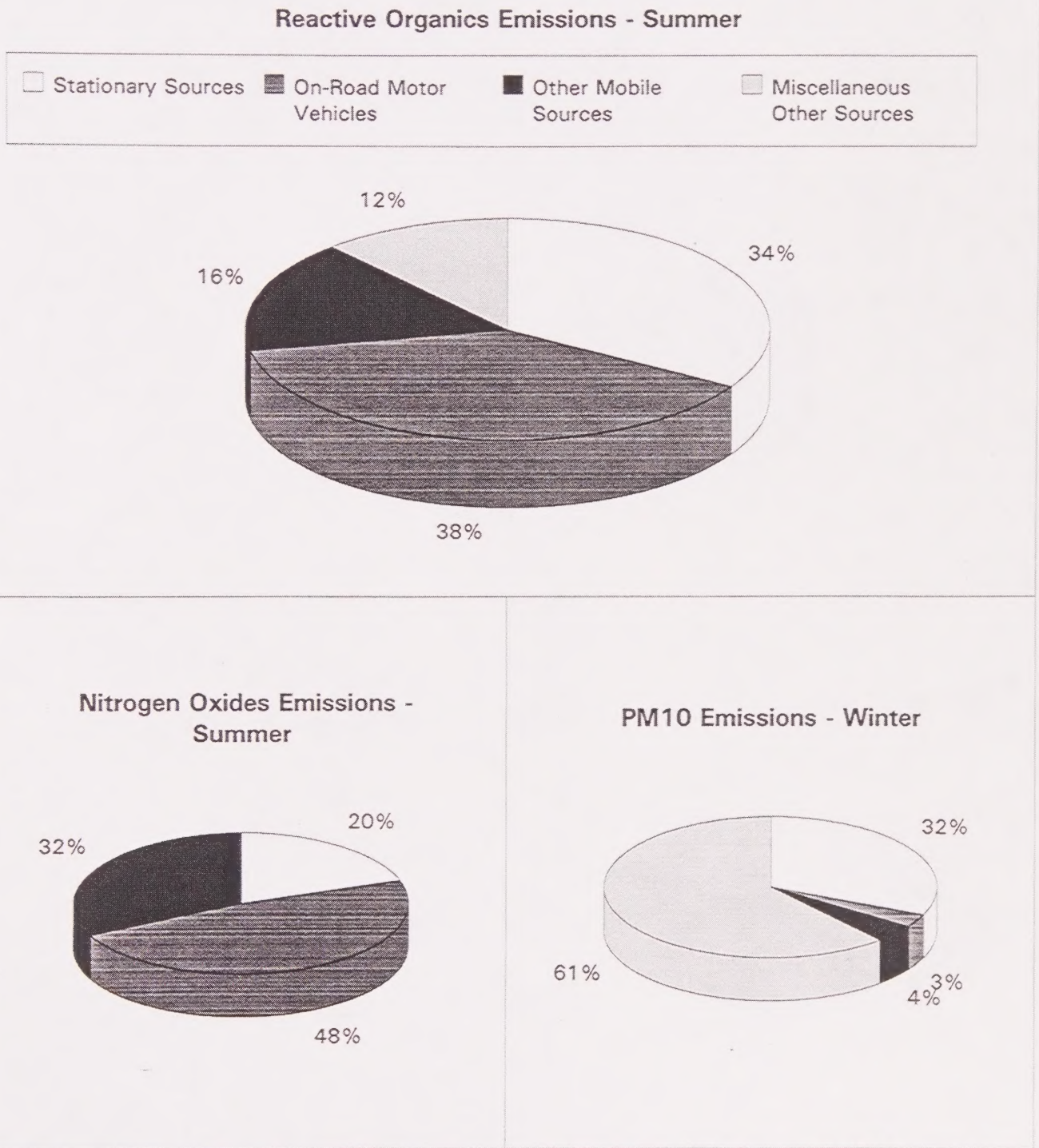


FIGURE G-6

Contribution of 2003 Emissions by Major Source Category